

# Bayes Theorem

Bayes' theorem describes the probability of occurrence of an event related to any condition. It is also considered for the case of conditional probability.

## Formula

$$P(A|B) = \frac{P(B|A) P(A)}{P(B)}$$

## Example

A bag I contains 4 white and 6 black balls while another Bag II contains 4 white and 3 black balls. One ball is drawn at random from one of the bags, and it is found to be black. Find the probability that it was drawn from Bag I.

Solution:

Let  $E_1$  be the event of choosing bag I,  $E_2$  the event of choosing bag II, and  $A$  be the event of drawing a black ball.

$$P(E_1) = P(E_2) = \frac{1}{2}$$

$$P\left(\frac{A}{E_1}\right) = P(\text{drawing a black ball from bag 1}) = \frac{6}{10} = \frac{3}{5}$$

$$P\left(\frac{A}{E_2}\right) = P(\text{drawing a black ball from bag 2}) = \frac{3}{7}$$

$$P\left(\frac{E_1}{A}\right) = \frac{P(E_1) * P\left(\frac{A}{E_1}\right)}{P(E_1) * P\left(\frac{A}{E_1}\right) + P(E_2) * P\left(\frac{A}{E_2}\right)}$$

$$P\left(\frac{E_1}{A}\right) = \frac{\frac{1}{2} * \frac{3}{5}}{\frac{1}{2} * \frac{3}{5} + \frac{1}{2} * \frac{3}{7}} = \frac{7}{12}$$